

in this country few developments have been made. More attention has been given probably in England to the binocular microscope than to any other form of stereoscopic instrument. Quite recently Theodore Brown has experimented with a method of monocular bio-stereoscopic projection, which will doubtless one day be perfected and become widely known. But only his earlier work is mentioned by von Rohr, who does not carry his account beyond 1900. For the same reason, perhaps, we find no mention of the Forbes stereoscopic range-finder, or of the Aitchison prism binocular.

To those interested in the history of optics, and more especially to workers in stereoscopy, von Rohr's compilation will be of great value. For the general reader it is to be feared the technical manner in which the subject is presented throughout will prove somewhat of a stumbling block. This is, we think, a matter for regret.

AMERICAN PHYSICAL GEOGRAPHY.

Physiography. By Prof. R. D. Salisbury. Pp. xx+770; xxvi plates, 707 figures. (London: J. Murray, 1907.) Price 21s. net.

THE large three-volume text-book of geology by Profs. Chamberlin and Salisbury has gained a firm place in this country owing to its full treatment of many questions, inadequately discussed in previous available English text-books. This companion volume on physical geography by Prof. Salisbury will accordingly be welcomed by British teachers of geology and geography. It is of great educational value owing to its wealth of lucid illustration and its clearness of exposition, while it will be indispensable as a reference work in geographical libraries owing to its detailed information regarding the physical geography of the United States.

The book is entitled "Physiography," but the term is used, as the author remarks in his introduction, as a synonym for physical geography, for it excludes many subjects which are included in physiography as that science was defined by Huxley and is accepted in the British Isles. The book consists in the main of a description of the structure of the earth's crust, of the working of the various agencies that attack it, and an account of the atmosphere and the oceans in so far as they affect the surface of the earth. Perhaps the most striking feature of the book is its illustrations, which are very numerous, well selected, and excellently reproduced. They are so clear that the author has been able to abridge his text, leaving his series of photographs to tell their own story. The excellence of the illustrations is probably in part secured by the use of heavy paper, so that the volume is of such weight as to hamper its use as a student's text-book.

As a book of reference its especial value is in its descriptions of the phenomena of physical geography taken from a country where the illustrations are unusually clear and suggestive; and it gives most useful summaries of such well-known geographical incidents as the San Francisco earthquake and of the fault which caused it; of the storm which destroyed Gal-

veston in 1900, and the tornado which devastated Louisville in 1896.

In the chapter on the "weather-maps," the author summarises various reasons for the failure of weather predictions, and he remarks that occasional mistakes are inevitable, and that one mistake is remembered longer than many correct forecasts. He claims that in many cases the American forecasts have been of immense economic value; for example, fifteen million dollars' worth of property were saved in 1897 by warnings of impending floods; on one occasion half a million dollars' worth of fruit about Jacksonville, in Florida, and during 1901, 3,400,000 dollars' worth of produce were saved by warnings of approaching cold; the forecasts also render it possible to avoid unnecessary risks, as when, in September, 1903, vessels valued at 585,000 dollars were detained in ports on the coast of Florida, and thus avoided a heavy storm.

In a work of so wide a scope there are naturally many points on which there is room for difference of opinion, but the author is cautious and fair in his treatment of all controverted questions. We are glad to find that he is emphatic in his statement that the term "Gulf Stream" is of doubtful propriety for anything beyond Newfoundland, and that the climate of north-western Europe would be much more temperate than that of corresponding latitudes of North America even if there were no Gulf Stream (pp. 544-5).

He holds that the only explanation of glacial periods which has not been discredited is that based on variations in the composition of the atmosphere. In his discussion of the question there is no criticism of Schloesing's view as to the control of the amount of atmospheric carbonic acid by the sea. The author is a firm adherent of the view of the ice erosion of fiords.

Each chapter is followed by a table of useful exercises, and by a list of references to literature. They are mainly from American sources, which is natural in a book designed for American students, but an English edition might have included more references to work easily available to British students; for instance, among the excellent illustrations and account of the eruption of Mt. Pelée and St. Vincent, there is no reference to the reports of Anderson and Flett. It may also be remarked that the Aconcagua ascent no longer holds the record, and that while it did, Zurbriggen was not the only man who had made it.

J. W. G.

POLYPERIODIC FUNCTIONS.

An Introduction to the Theory of Multiply-Periodic Functions. By Dr. H. F. Baker. Pp. xvi+33b. (Cambridge: University Press, 1907.) Price 12s. 6d. net.

THE saying that *Il n'y a que le premier pas qui coûte* certainly does not hold good of mathematics; and, oddly enough, it conspicuously fails in cases where it might be expected to justify itself. It is but a step from elliptic to hyperelliptic, from single to double Theta-functions; yet whereas Jacobi reduced all the essential theory of elliptic functions to a most elegant, and for some purposes a final,

shape, it is only now becoming possible to construct a corresponding theory for the hyperelliptic functions.

Towards this Dr. Baker, in the first part of his treatise, has made a really valuable contribution. The first chapter contains an extremely clear account of the hyperelliptic integrals, and in particular gives the standard ones in their explicit algebraic form. The corresponding Theta-functions are defined, and their properties investigated; the solution of Jacobi's inversion problem is given in an unusually clear form, and art. 10 contains an instructive discussion of the vanishing of a double Theta-function—perhaps one of the most troublesome points in the whole theory.

Chapter ii. contains the differential equations for the Sigma-functions which are afterwards used to find their expansions. By means of Aronhold's symbolical notation they are expressed in a compact invariantive form; and the way in which they are obtained is an elementary one. At the same time, as the author would probably admit, the process is that of leading up to a known result, and not a heuristic one; this is not said by way of disparagement, because it often happens that tedious methods of discovery are properly replaced by others of a more artificial kind. Dr. Baker, in a note at the end, directs attention to the desirability of re-casting the demonstration so as to make it more strictly analogous to the method used for the elliptic Sigma-function.

Chapter iii. deals with the properties of Kummer's surface and Weddle's surface in connection with the properties of the hyperelliptic functions. Here the author's powers of dealing with algebraical analysis appear to great advantage. He has expressed the principal results in a form that is both explicit and elegant; and the English reader who has this book and Hudson's "Kummer's Surface" will be able to attack, if he likes, a very interesting and unusually definite field of research. Chapter v. is of a similar character, and contains, among other things, Mr. Bateman's proof of the differential equation of the asymptotic lines on Weddle's surface, and a geometrical interpretation of the addition theorem. Chapter iv. deals with the expansions of the Sigma-functions, and gives a great number of explicit terms; the invariantive character of the coefficients should be specially noticed.

The second part of the book, "on the reduction of the theory of multiply-periodic functions to the theory of algebraic functions," is of a much more recondite and difficult character. One of its main objects is to prove the theorem that the most general single-valued multiply-periodic meromorphic function is expressible by Theta-functions. The proof given partly depends upon Kronecker's theory of the definition of algebraic constructs (*Gebilde*) by means of systems of equations, partly upon the consideration of a set of "defective" integrals. Dr. Baker is admirably honest, and on p. 207 makes the remark:—"It seems certain that the values of k_{rs} can be taken so that the determinant $[c_{rs}]$ is not zero"; the temptation to make this a positive statement instead of a conjecture would have been considerable to many writers. Whether or not Dr. Baker's proof will stand minute

examination in all its parts remains to be seen; it is at any rate an original and very interesting discussion of an extremely difficult and important problem. It is not easy at the present time to foresee what will be the ultimate shape assumed by the general theory of Abelian functions. So far as mathematical rigour is concerned, as well as in its definiteness and attention to detail, the work of Weierstrass is preeminent, and its influence may be continually noted, and is frequently acknowledged in the present treatise. On the other hand, the more intuitive methods of Riemann and his followers are extremely illuminating and fruitful in suggestions and results; while as regards algebraic functions, the method of Dedekind and Weber is very hard to improve upon. One main difficulty, of course, is the increase in the number of independent variables in the associated Theta-functions; to get a "geometrical" field for the variables we must either plunge into unknown spaces or take new elements (*e.g.* straight lines) in our own.

Much light on the general theory and its difficulties is afforded by some special examples which Dr. Baker gives here and there, for instance, on pp. 255-72. In fact, an accumulation of such examples would greatly help beginners to grasp the arguments of the general theory.

In conclusion, attention may be directed to the great economy of space which the author obtains by abbreviated notation for matrices. The only drawback is that matrices are continually denoted by letters of the same type as those indicating quantities. Moreover, double Theta-functions are expressed in the form $\theta(u)$, which stands for $\theta(u_1, u_2)$; consequently, the beginner must be careful to realise the full meaning of the symbols, and he must at once make himself familiar with the elementary theory of matrices. Perhaps, in another edition, matrices might be indicated by letters of a special type.

G. B. M.

REINFORCED CONCRETE.

Principles of Reinforced Concrete Construction. By F. E. Turneaure and E. R. Maurer. Pp. viii+317. (New York: John Wiley and Sons, 1907.)

THIS is the latest text-book on a branch of engineering construction which during the past ten years has developed from its first small beginnings to such an important position that not only is it essential for civil engineers and architects to be familiar with its various applications, but they should also have a sound knowledge of the principles which underlie the design of reinforced concrete structures. The authors have therefore practically divided the book into two sections, the first part dealing with the theory of the subject, the results of tests, and such questions as working stresses and economical proportions, while the second part is devoted to the application of reinforced concrete to building construction, arches, retaining walls, &c.

After discussing fully the properties of the two materials, concrete and steel, both when used independently and when used in combination, the authors proceed to obtain working formulæ for the